POTENTIAL WESTERN HEMISPHERE SHOREBIRD RESERVE NETWORK SITES FOR MIGRANT SHOREBIRDS IN CANADA

R.I.G. Morrison, R.W. Butler, H.L. Dickson,
A. Bourget, P.W. Hicklin and J.P. Goossen

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ABSTRACT

The Western Hemisphere Shorebird Reserve Network (WHSRN) is an international conservation initiative designed to protect the key habitats and resources used by shorebirds throughout their migrations ranges. Many species of shorebirds depend on a chain of critically important sites to complete their annual migrations, and for conservation to be successful, all the links in the chain need to be preserved. This report is intended as a first inventory of potential WHSRN sites in non-Arctic areas of Canada: it summarizes information currently available on locations meeting criteria for inclusion in the Western Hemisphere Shorebird Reserve Network and discusses the methods used to establish those criteria.

RESUME

Le Réseau de réserves pour les Oiseaux de rivage de l'Hémisphère occidental est une initiative internationale de conservation visant à protéger des habitat clés et les ressources utilisées par les oiseaux tout au long de leurs étapes migratoires. Plusieurs espèces d'oiseaux de rivage dépendent d'une chaîne de sites importants pour compléter leurs migrations annuelles. Afin que les efforts de conservation soient efficaces, tous les sites critiques appartenant à la chaîne doivent être protégés. Ce rapport se veut un premier inventaire des sites potentiels de ce réseau, en dehors des zones arctiques canadiennes. Il fait le sommaire de l'information actuellement disponible sur les endroits qui rencontrent les critères permettant de les inclure dans le Réseau de réserves pour les Oiseaux de rivage de l'Hémisphère occidental. En outre, il discute des méthodes utilisées pour établir ces mêmes critères.

Potential Western Hemisphere Shorebird Reserve Network Sites for Migrant Shorebirds in Canada

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POTENTIAL WESTERN HEMISPHERE SHOREBIRD RESERVE NETWORK SITES FOR MIGRANT SHOREBIRDS IN CANADA

R.I.G. Morrison (1), R.W. Butler (2), H.L. Dickson (3), A. Bourget (4), P.W. Hicklin (5) and J.P. Goossen (3).

Introduction

Twenty-seven (64%) of the 42 species of shorebirds that occur regularly in Canada (Godfrey 1986) are long-distance migrants. Most winter in Central and South America, some as far south as Tierra del Fuego (Morrison 1984, Morrison and Ross 1989).

Research in North and South America over the past 15 years has identified many of the key areas used by the birds throughout their migration ranges, and has demonstrated that some species of shorebirds concentrate to a marked degree, with major proportions of the population occurring at only a few sites both during

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migration and on the wintering grounds (Morrison 1983a, 1984, Senner and Howe 1984, Morrison and Myers 1987, 1989, Morrison and Ross 1989). The birds depend on a chain of critically important sites to complete their annual migrations, each site providing the resources needed by the birds to enable them to reach the next area or to survive. For conservation to be successful, all the links in the chain need to be preserved, since removal of one vital area could disrupt the entire system.

Morrison (1983a, 1984) proposed an international system of linked reserves which would protect important sites required by the birds throughout their ranges. This led to the establishment of the Western Hemisphere Shorebird Reserve Network (WHSRN) (Myers et al. 1987a, 1987b), as well as the WHSRN Council, which stimulates development of the Network, gathers information on appropriate sites, and ratifies their inclusion in the WHSRN. The Network is essentially voluntary and collaborative in nature and depends on the cooperation of the countries and organisations with jurisdiction over the sites concerned for its successful operation.

Four categories of WHSRN sites are recognized:

Hemispheric Sites: support at least 500,000 shorebirds annually, or 30% of a species' flyway population. Hemispheric Sites are intended to include areas

supporting major concentrations of shorebirds, with daily totals reaching about 50,000 birds during migration;

International Sites: support at least 100,000 shorebirds annually, or 15% of a species' flyway population;

Regional Sites: support at least 20,000 shorebirds annually, or 5% of a species' flyway population; and

Endangered Species Sites: are critical to the survival of endangered species (no minimum number of birds is required).

Mechanisms for protection of potential WHSRN sites are variable, and will depend on who has ownership of or jurisdiction over the land concerned. For instance, sites may be protected through designation as a National Wildlife Area, Provincial Wildlife Management Area, "Ramsar" site, other appropriate reserve, or through "stewardship" arrangements with groups or individuals, and may be managed by a federal, provincial, state or private organisation as appropriate.

The Bay of Fundy Western Hemisphere Shorebird Reserve became the first WHSRN reserve to be created in Canada, with the dedication of two important areas in the upper Bay of Fundy: Shepody Bay in August 1987 (Hicklin 1988a) and the Minas Basin in August 1988 (Hicklin 1988b).

This report is intended to be a first inventory of potential WHSRN sites in non-Arctic areas of Canada: it summarizes information currently available on locations meeting WHSRN criteria and discusses the methods used to establish those criteria. Hemispheric, International and Regional sites generally involve staging areas used by shorebirds during migration, whereas Endangered Species sites refer to breeding areas used by the Piping Plover (see Appendix 1 for scientific names of species).

Sources of data

In addition to published data, information is drawn from Canadian Wildlife Service (CWS) survey operations, including: 1) in Atlantic Canada - the Maritimes/International Shorebird Survey (MSS/ISS) scheme, operated since 1974 (see Morrison and Campbell 1988); 2) in Quebec - CWS ground and aerial surveys (see Brousseau 1981, Maisonneuve 1982, Bourget 1988, 1989, 1990); 3) in Ontario - MSS/ISS data and CWS aerial surveys (James Bay/Hudson Bay); 4) in the Prairie Provinces - MSS/ISS data and CWS ground and aerial surveys (including Dickson and Smith 1988, Smith and Dickson 1989, H.L. Dickson unpubl. data); and 5) on the Pacific coast - CWS surveys (references appear in the relevant sections and Appendices below).

Classification of sites

Two classes of potential sites have been identified in the present paper:

(1) Sites for which present data clearly establish the status of the site, and for which conservational action may be considered.

Such sites generally involve those where the sum of the maximum counts for all shorebird species exceeds the criteria for the WHSRN category directly without any allowance for turnover (see below), and where the criteria are met in most years. Such sites are indicated without further qualification, e.g., Hemispheric or H, Regional or R, and are enclosed by solid lines in the Figures.

Turnover refers to the fact that at any given site the population will be constantly changing as different individual bird move through the area at different times during the period of migration: because of this "turnover", more birds will use a site than is apparent from the maximum count. Estimation of the total number of shorebirds using the site (i.e., allowing for turnover) may not be straightforward, since the length of stay varies for different species in different areas (see Discussion).

(2) Sites where the status is less certain, and for which further information should be sought.

Examples include sites where the maximum count totals for all shorebird species do not directly reach the minimum required, but where it is considered that the total number of shorebirds using the site would exceed the minimum when turnover is taken into account. Other cases of uncertainty of status for a site may occur where the criteria are only occasionally met, or have been met in the past but not in recent years. Such sites are indicated with a question mark after the category throughout the report, e.g., Regional? or R?, by being bracketed in the text (if R? only), and by dashed lines in the Figures. Where it is uncertain whether a site might qualify as a Hemispheric or International site, but clearly qualifies as a Regional site, then it may be classified as, for example, I?/R. Endangered species sites (E) are indicated as such, in addition to any other category for which they may qualify, e.g. R/E, E, R?/E. Some flexibility in use of the criteria has been taken to help ensure that areas for which further information is required are included, but for which immediate conservational action may not be warranted.

Results

Fifty-one potential and/or declared WHSRN sites for migrant shorebirds have so far been identified in Canada (Table 1, Figure 1). Many sites involve single locations, while others consist of several geographical features grouped together (e.g., groups of lakes) (see Appendices 2-6).

Potential Hemispheric Reserves include one on the east coast (the two arms of the upper Bay of Fundy), two on the Prairies, and one in southern British Columbia (Fraser River delta). Other areas of possible Hemispheric status include parts of the James Bay coast in northern Ontario and the Quoddy Region off the coast of New Brunswick. Two potential International Reserves were identified, one in southern Saskatchewan and one on the Alberta/Saskatchewan border, with a further possible site at the mouth of the Bay of Fundy. Regional Reserve sites are found across Canada at both coastal and inland locations. Endangered Species sites involve breeding areas for Piping Plover: potential and possible Endangered Species sites include ten areas in the Prairies (six of which also qualify in other categories), one in western Ontario, one in Quebec, and three areas of the Maritime Provinces involving a series of breeding sites. All sites qualifying for inclusion in the WHSRN system may be considered to be of international importance for shorebirds. Brief accounts of these sites are presented on a regional basis below.

Table 1. Numbers of potential Western Hemisphere Shorebird Reserve Network sites (grouped where appropriate, see text) in various regions of Canada.

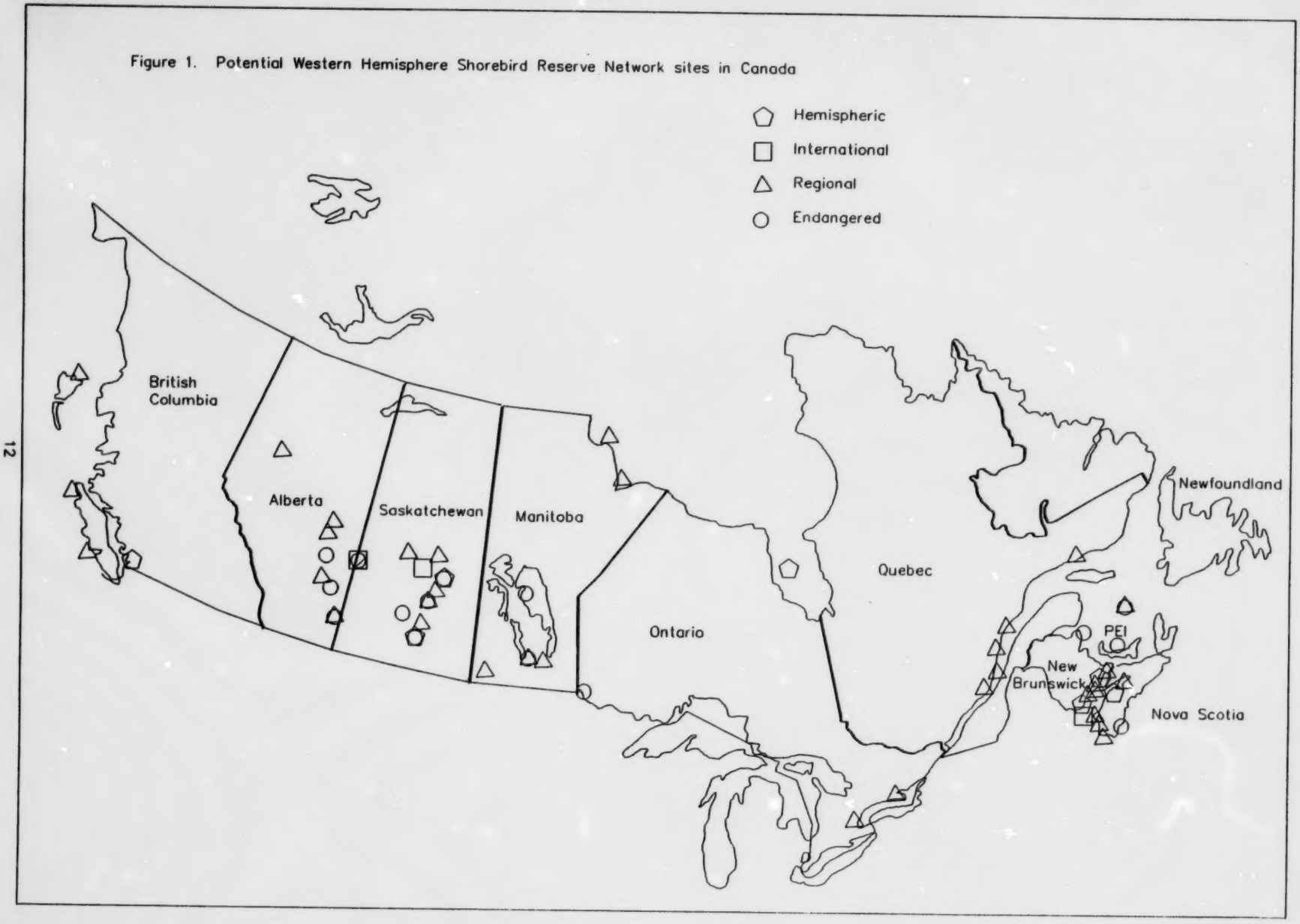
	WHSRN Category*												
Region	H		H?		I		I?		R		R?	E**	E?	Total
Atlantic	1		1		-		1		4		4	-	3	14
Quebec	-		-		-		-		3		3	1	-	7
Ontario	-		1		-		-		-		2	-	1	4
Prairies	2		-		2		-		11		3	3(6)	1	22
Pacific	1		-		-		-		1		2	-	-	4
Total	4		2		2		1		19		14	4(6)	5	51 (6)

* Site categories: H = Hemispheric, I = International, R = Regional, E = Endangered, see text for definitions

? indicates site does not qualify directly from existing count data

** Figures in brackets for E category indicate sites also qualifying for inclusion in another category

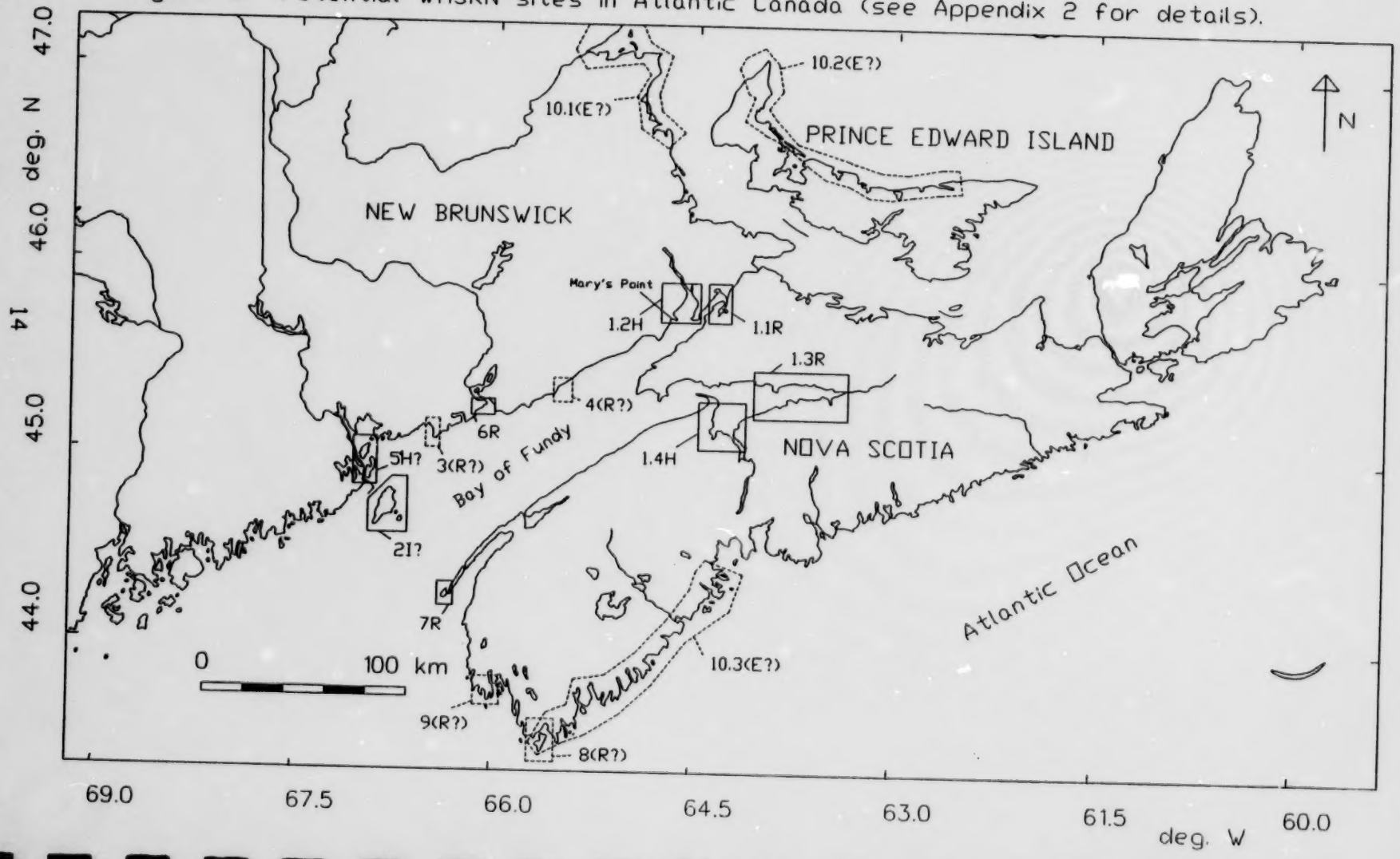
Figure 1. Potential Western Hemisphere Shorebird Reserve Network sites in Canada



ATLANTIC CANADA

The most important areas for shorebirds on the east coast of Canada are found around the upper Bay of Fundy (Morrison and Harrington 1979, Hicklin 1987) (Figure 2, Appendix 2). The upper bay can be divided into two main areas, the north/northwest arm, comprising Chignecto Bay, Shepody Bay and Cumberland Basin, and the east/southeast arm, consisting of Minas Basin and Cobequid Bay. These areas contain over 80% of both the intertidal flats (total 35,000 ha) and the saltmarsh (total 5,000 ha) in the Bay of Fundy (Pearce and Smith 1974, Hicklin and Smith 1984). Many species make a direct, trans-ocean flight to South America from these areas. The combination of an abundant food supply on the wide intertidal flats, and suitable beaches and other areas for roosting, provides the resources needed by the birds to accumulate the large energy reserves required for completing their flights (Morrison and Harrington 1979, Hicklin et al. 1980, Hicklin and Smith 1984, Peer et al. 1986). Semipalmated Sandpipers are by far the most numerous species, though the area is of considerable importance to a wide range of shorebirds. The highest numbers occur in the north/northwest arm of the Bay of Fundy, especially around Shepody Bay, though large numbers are also found in Minas Basin and Cobequid Bay. These areas together form the Bay of Fundy Western Hemisphere Shorebird Reserve.

Figure 2. Potential WHSRN sites in Atlantic Canada (see Appendix 2 for details).



1. Bay of Fundy Western Hemisphere Shorebird Reserve (Hemispheric)

1.1 Cumberland Basin, NB/NS (Regional)

1.2 Shepody Bay, NB (Hemispheric, declared 1987)

1.3 Cobequid Bay, NS (Regional)

1.4 Minas Basin, NS (Hemispheric, declared 1988)

The extensive intertidal flats and associated roosting areas surrounding Shepody Bay/Mary's Point, NB, support the highest numbers of migrant shorebirds known to occur in eastern North America. Shepody Bay is a large tidal embayment containing some 4,000 hectares of intertidal flats, which extend for up to 2 km seaward at Grande Anse and Daniel's Flats on the east and west sides of the bay, respectively. The west side is lined with a narrow band of salt marsh. The east side is rockier and includes sand-gravel beaches used by the birds for roosting. At the mouth of the bay, the Mary's Point peninsula encloses another 940+ hectares of mudflats forming the New Horton Flats, with sand and gravel beaches forming the principal roosting sites on the south side of the point.

Counts of Semipalmated Sandpipers at Mary's Point ranged between 80,000 and 350,000 during Maritimes Shorebird Surveys from 1974 to 1986. Some 800,000-1,000,000 birds were estimated to be present for one day after a period of bad weather in 1975

(Morrison 1976). The area is also important for Semipalmated Plovers, Black-bellied Plovers, Red Knots, Short-billed Dowitchers, Least Sandpipers and White-rumped Sandpipers, and supports wintering populations of Purple Sandpipers. For all species combined, the average peak number seen at Mary's Point is approximately 165,000 birds (see Hicklin 1987).

Mary's Point/Shepody Bay became the first Canadian site in the Western Hemisphere Shorebird Reserve Network on 8 August 1987 (Hicklin 1988a), forming one element of the Bay of Fundy Western Hemisphere Shorebird Reserve.

On 10 August 1988, the Minas Basin, NS, was dedicated as the second element of the Bay of Fundy Western Hemisphere Shorebird Reserve (Hicklin 1988b). Numbers at individual roost sites are generally less than in the Shepody Bay/Mary's Point area. Counts in the southern bight of the Minas Basin have ranged up to approximately 25,000 (Appendix 2), with a peak count at the most important site, Evangeline Beach, of 40,000 Semipalmated Sandpipers (Hicklin 1987). Aerial surveys of the Minas Basin in mid/late August by R. Hall and A. MacInnis of the NS Dept. of Lands and Forests produced totals of 25,180 and 16,630 in 1978 and 1979, respectively (Morrison and Gratto 1979, Morrison 1983b).

The Cumberland Basin, situated in the north/northwest arm of

the upper Bay of Fundy, contains some large areas of mudflats, and the extensive Tantramar marshes near Sackville, NB. Large numbers of Semipalmated Sandpipers (30,000 in 1978, Morrison and Gratto 1979, Hicklin 1987) feed and roost at Minudie, NS. This area should be considered part of the Bay of Fundy Western Hemisphere Shorebird Reserve.

Cobequid Bay comprises the inner part of the east/southeast arm of the Bay of Fundy, and contains extensive mud and sandflats backed by rolling terrain. Maximum counts of shorebirds at various sites in Cobequid Bay from Maritimes Shorebird Survey censuses total between 35,500 and 43,120 (Appendix 2), and numbers observed during aerial surveys conducted by R. Hall and A. MacInnis of the NS Department of Lands and Forests in 1978 and 1979 were 26,400 and 33,750, respectively (Morrison and Gratto 1979, Morrison 1983b). The area should also be considered part of the Bay of Fundy Western Hemisphere Shorebird Reserve.

2. Grand Manan area, NB (International ?)

Several reports of very large numbers of phalaropes, involving mostly Red-necked Phalaropes, in concentrations of up to 100,000 birds, have been made from the Grand Manan area, though further surveys are needed to document the phenomenon adequately, especially in view of the recent apparent decline in

phalarope numbers in Passamaquoddy Bay (see Quoddy region, NB, below).

[3. Maces Bay, NB (Regional ?)

Maces Bay supports moderate numbers (approximately 5,000-14,000 birds in 1975-1977) and an interesting diversity (16 species) of shorebirds during autumn migration. The very extensive rocky intertidal zone is used by some of the largest recorded concentrations of Purple Sandpipers in the Maritime Provinces during the winter (525+ birds, Morrison unpubl. data).]

[4. Quaco Bay, NB (Regional ?)

Moderate concentrations of shorebirds have been recorded using the flats at Quaco Bay in some years (e.g., approximately 9,000 in 1974).]

[5. Quoddy region, NB (Hemispheric ?)

The narrow passages and very strong currents running through the entrances to Passamaquoddy Bay, especially between Deer Island and Campobello Island, NB, produce upwellings and areas of high marine productivity that attract very large concentrations

of seabirds and Red-necked Phalaropes. During the 1970s and early 1980s, numbers of phalaropes reported from the area varied between 15,000+ and 2,000,000 and were consistently in the hundreds of thousands to one million range (Appendix 2). The low number of 15,000+ in 1978 was attributed to a failure of Euphausids that year (Vickery 1979). Since 1985, however, very few phalaropes at all have been seen in the area (Hicklin pers. obs., R.G.B. Brown pers. comm., Duncan in litt.). The reasons for this major change in numbers or distribution are not yet fully understood.]

6. Saints Rest marsh and beach, St. John, NB (Regional)

The sandy beach and mudflats at Saints Rest Beach, flanked by rocky beaches and points and backed by the marshes along the Manawagonish River, provide an interesting diversity of habitats that have regularly supported over 20,000 shorebirds during autumn migration, with a reported maximum of 111,500 in 1986 (Appendix 2).

7. Brier Island, NS (Regional)

Brier Island is noted for the concentrations of Red Phalaropes occurring offshore, where currents flowing over a

submerged ledge result in highly productive feeding areas for seabirds and pelagic shorebirds (Brown 1980). Vickery (1979) reported that approximately 20,000 phalaropes occurred routinely during late August, though numbers are apparently variable from year to year depending on oceanographic conditions (R.G.B. Brown in litt.). It is uncertain whether the large decline in Northern Phalaropes seen in Passamaquoddy Bay (see above) has also occurred with the Red Phalaropes off Brier Island.

[8. Cape Sable, NS (Regional ?)

Maximum counts at this site have ranged between 6,520 and 10,830 from 1977 to 1984. The area contains extensive sandflats and may support over 20,000 shorebirds during the year.]

[9. Cook's Beach, NS (Regional ?)

Maximum counts at this site reached approximately 8,000 during Maritimes Shorebird survey operations in 1982 and 1983 (Appendix 2), and the site may support over 20,000 shorebirds during the course of the year.]

[10. Maritimes Piping Plover sites, NB, PEI, NS (Endangered?)

10.1 Eastern shore, New Brunswick (E?)

10.2 Northern shore, Prince Edward Island (E?)

10.3 Southern shore, Nova Scotia (E?)

Some 200 pairs of Piping Plover are spread over the coastline of the Maritime Provinces, with small numbers nesting on sandy beaches along the shores of both the Atlantic Ocean and Gulf of St. Lawrence (CWS unpubl. data). While it is difficult to single out individual sites for WHSRN reserve status, three sections of the coast are of particular significance to the species: the eastern shore of New Brunswick, the north coast of Prince Edward Island, and the southern shore of Nova Scotia.

Fifteen (15%) of the 100 pairs of Piping Plover that nest in New Brunswick are found within Kouchibouguac National Park. In 1991, six other beaches supported 7-10 pairs of Piping Plovers: five of the sites were located on the northeast shore north of Miramichi Bay, with the sixth located near Bouctouche.

Approximately one half of the Piping Plovers nesting in Prince Edward Island are found within the Prince Edward Island National Park. Other breeding sites are located mainly along the north shore and support one or two pairs up to a maximum of five pairs per beach.

The largest concentration (10 pairs) of Piping Plovers breeding in Nova Scotia in 1991 was found in the Kejimkujuk National Park Seaside Adjunct. Other sites generally consisted of small beaches with a maximum of one or two pairs per beach.

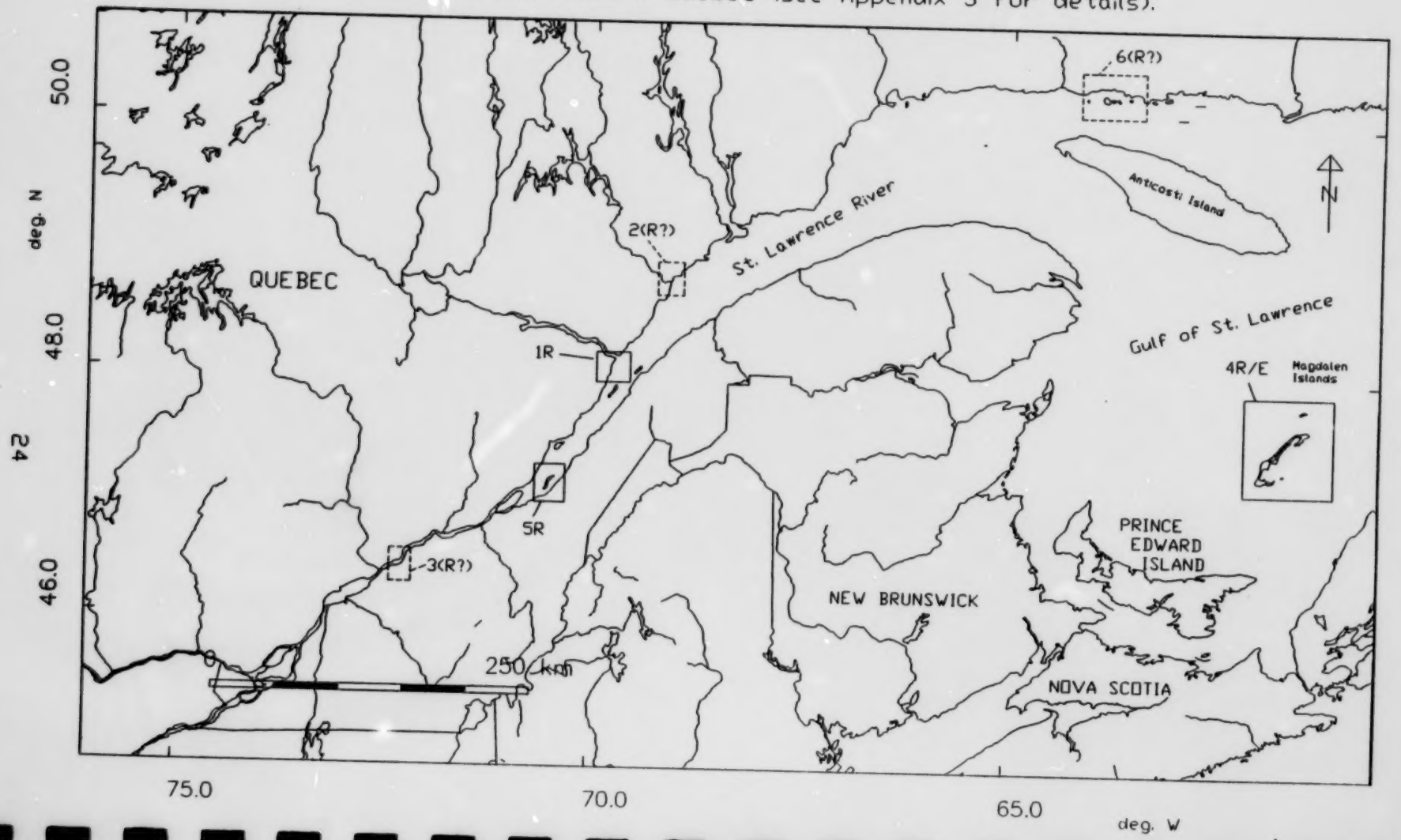
Seven Piping Plovers were reported near Burgeo, Newfoundland, in June 1991, but it is not known whether the species breeds regularly in the province (B. Johnson pers. comm.).

QUEBEC

All currently listed sites within Quebec are potentially Regional Reserves, with one area also of significance as an Endangered species site (Figure 3, Appendix 3). Only two, the Magdalen Islands and the Battures aux Loups-marins, qualify directly with maximum counts of shorebirds totalling over 20,000. The other sites listed, with totals of 5,500-16,700, likely support over 20,000 shorebirds during the course of migration when turnover is taken into account. The shoreline of the St. Lawrence River clearly supports significant numbers of shorebirds during migration, with heavy use being made of intertidal areas formed at low tide in shallow parts of the offshore channel. Sites along the north shore of the lower parts of the river appeared to support significant numbers of Red Knots, Ruddy Turnstones and White-rumped Sandpipers. There are few detailed counts from potential sites in the north of the province, though parts of the east coast of James Bay and of the southern coast of Ungava Bay are undoubtedly important for shorebirds.

Development, pollution, disturbance and habitat deterioration have reduced numbers in several localities. For instance, Maizerets (near Quebec City), which was partially filled by road construction, was reported by Brousseau (1981) to have supported up to 40,000 Semipalmated Sandpipers during the

Figure 3. Potential WHSRN sites in Quebec (see Appendix 3 for details).



peak of migration in 1973. Today, however, the remaining habitat supports only a few thousand shorebirds (A. Bouget pers. obs.). At the Magdalen Islands, the construction of the main road in 1956 and the partial closure of the outlets of the lagoon of Havre aux Basques by dikes, has affected the tidal regime in this habitat and is probably responsible for the important changes in bird numbers noted since the visits by Hagar (1949, 1956).

1. Saguenay River area, Que (Regional)

1.1 Battures aux Allouettes (Regional ?)

1.2 Ile Rouge (Regional ?)

1.3 Ile Blanche (Regional ?)

At Battures aux Allouettes, an enormous area of sandy bottoms, mudflats and pebble beaches is exposed at low tide along the north shore of the St. Lawrence estuary near the mouth of the Saguenay River. The area is vast and can only be partially censused from the shore because resting areas and tidal pools used for feeding occur up to 5 kilometres offshore. The total numbers of birds using the area are thus likely to be considerably higher than those shown in Appendix 3.

Ile Rouge is a small island (4 ha) located almost in the middle of the St. Lawrence estuary opposite the mouth of the

Saguenay River. Its shoreline consists of rounded pebbles and a sandbar is exposed off its eastern tip at low tide. The site is used for roosting by several species of shorebirds and gulls at high tide when the nearby feeding grounds at Battures aux Allouettes are submerged. The area was notable for the highest recorded count of Black-bellied Plovers (10,000) along the St. Lawrence River in 1981 (Appendix 3).

Ile Blanche, which is part of the Iles de l'estuaire National Wildlife Area, is a small island (4.5 ha) located a few kilometres west of Ile Rouge, and likely shares the same birds from feeding grounds on the north and south sides of the St. Lawrence estuary. Extensive flats composed of sedimentary rocks dotted with tidal pools surround the island at low tide. Shorebirds roost on the small rocky outcrops that remain exposed at high tide.

[2. Banc de Portneuf (Regional ?)

A long sandbar running parallel to the shore encloses a tidal gully containing sandy and muddy substrates used by shorebirds for feeding at low tide. A small saltmarsh with a few tidal pools occurs at the upper end of the gully. Birds roost on nearby beaches. The area supported one of the largest concentrations of White-rumped Sandpipers (6,000) recorded in the

region in 1981 (Appendix 3).]

[3. Gentilly (Regional ?)

The area used by shorebirds is located at the mouth of the Gentilly River and consists of 115 ha of emergent vegetation and mud. The area is only slightly influenced by the tide and is used as a feeding ground. Up to 10,000 Semipalmated Sandpipers and 1,500 Lesser Yellowlegs have been recorded at the site.]

4. Iles de la Madeleine (Regional/Endangered)

The Iles de la Madeleine (Magdalen Islands) form an archipelago situated in the middle of the Gulf of St. Lawrence. Shorebird habitats consist principally of tidal lagoons that have formed between sand dunes connecting the various islands. Shorebirds use habitats throughout the archipelago, but the most important section is at Havre-aux-Basques, where brackish marshes have formed between Ile du Cap aux Meules and Ile du Havre Aubert. The area is clearly of considerable importance for shorebirds. Hagar (1956) estimated that up to 6,000 Black-bellied Plovers, 10,000 White-rumped Sandpipers and 12,000 Semipalmated Sandpipers used the island, though these figures were higher than those reported during an earlier visit (Hagar

(1949). Peep migration was reported to peak at 37,000 in 1978 (D. Lehoux pers. comm., MSS unpubl. data). Figures from later censuses (Appendix 3) are somewhat lower, but include significant numbers of a variety of species. The Iles de la Madeleine are also the only site in Quebec where a small population of Piping Plover (37 pairs and four single adults in 1987, Shaffer and Pineau 1987) is known to breed. These plovers represent about 4% of the Atlantic Piping Plover population (Haig and Oring 1988, S. Haig unpubl. data).

5. Montmagny Archipelago (Regional)

5.1 Montmagny (Regional ?)

5.2 Battures aux Loups-marins (Regional)

Sedimentation at Montmagny has resulted in the formation of an extensive soft mud flat (980 ha) and Scirpus marsh (375 ha) on both sides of the mouth of Riviere du Sud. The area is used exclusively for feeding by shorebirds at low tide, and includes part of the migratory bird refuge designed for the protection of Greater Snow Geese along the St. Lawrence. Counts of shorebirds at the site were amongst the highest recorded along the St. Lawrence in recent years (Appendix 3).

At Battures aux Loups-marins, a large (545 ha) rocky flat

interspersed with muddy depressions forms around three small islands at low tide. The depressions are colonized by green algae that provide cover for small crustaceans and molluscs. Shorebirds feed around these pools at low tide and roost on exposed rock outcrops and pebble beaches at high tide. The area supports the largest recently recorded concentration of Semipalmated Sandpipers along the St. Lawrence estuary, and substantial numbers of Semiplamated Plovers and Ruddy Turnstones were counted at the site (Appendix 3).

[6. Minganie (Regional ?)

This area is part of the Mingan Archipelago National Park Reserve. Some of the islands in the western part of the archipelago support important concentrations of shorebirds. The birds feed on the large flats that are crossed with channels at low tide, and roost on certain of the islands at high tide. The area was notable for the largest concentration of Red Knots found to date along the St. Lawrence, and also supported fairly large numbers of White-rumped Sandpipers (Appendix 3).]

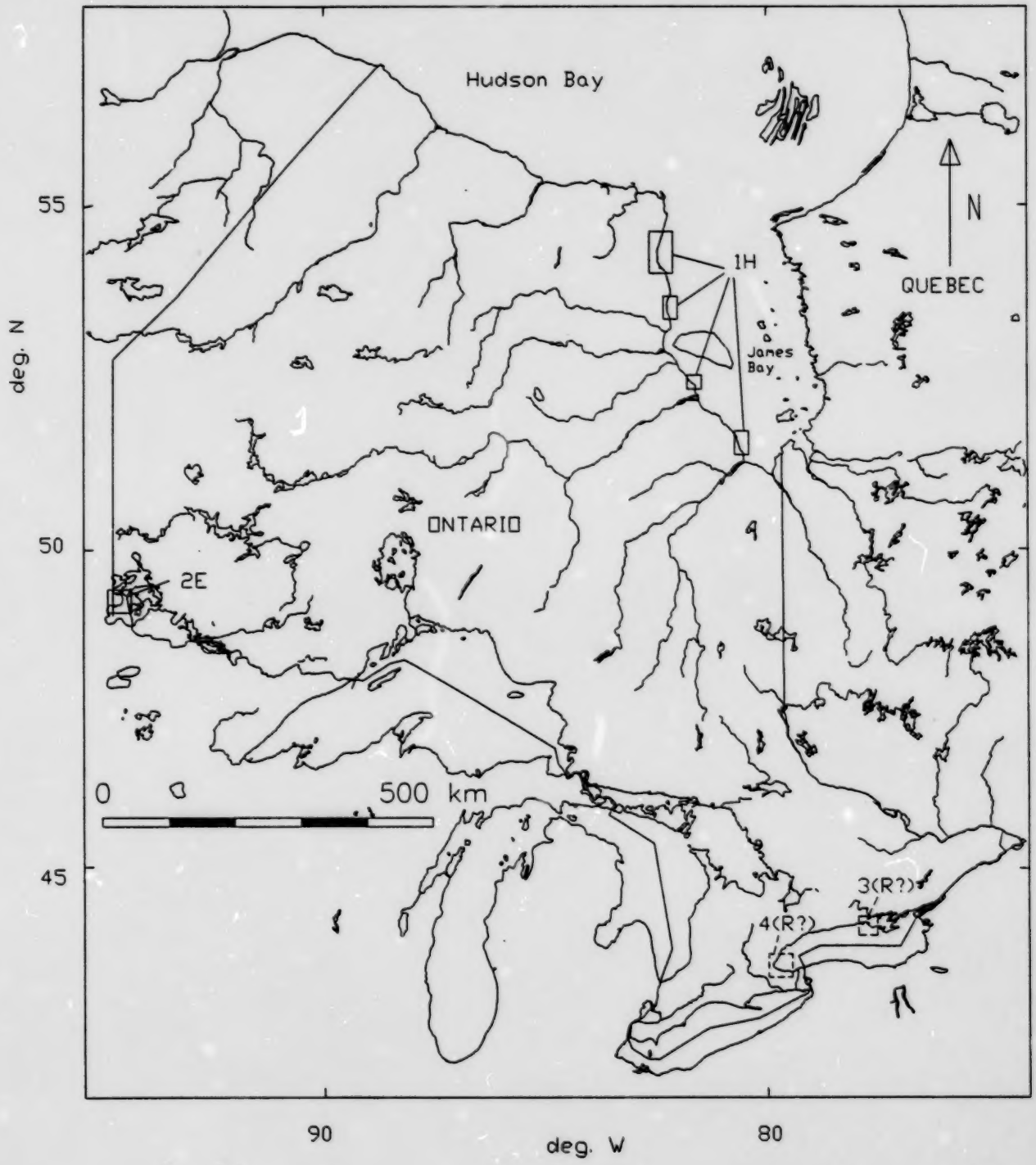
ONTARIO

The most important habitats for shorebirds in Ontario are found along the coasts of James Bay and Hudson Bay (Figure 4, Appendix 4). Habitats in the south of the province are generally smaller in area and are located along the shores of the Great Lakes or of other lakes and rivers. Many of these are affected by fluctuating water levels and thus may vary in importance from year to year, depending on the amount and quality of habitat available. Most are affected by developments, pollution, or by increasing recreational use by humans. Few of the numerous lakes in northern and central Ontario are thought to have habitats suitable for shorebirds.

1. James Bay (Hemispheric?/International)

The west coast of James Bay is very flat, and consists of extensive tidal flats and wide salt marshes which form a major migration route for many species of shorebirds (Morrison and Harrington 1979, Morrison and Gaston 1986). A variety of intertidal substrates occurs, from soft mudflats to sandflats, backed by characteristic marshes of various types, and beach ridge systems (see e.g. Martini 1981). Shorebirds concentrate in preferred areas, apparently where food resources are most

Figure 4. Potential WHSRN sites in Ontario (see Appendix 4 for details).



abundant (Morrison 1983a). The coast is of major international importance for the Red Knot (aerial survey counts ranging from 7,000-15,000 from 1974-1990) and Hudsonian Godwit (10,000 observed north of the Albany River in 1974), and supports large numbers of other species (aerial survey totals up to 60,000) (Appendix 4). Areas of particular importance include parts of southern James Bay between the Moose River and Longridge Point, areas north of the Albany River, and coastal sectors in the north of the bay around the Swan River and Lakitusaki/Nowashe rivers.

[2. Lake of the Woods (Endangered Species ?)

The sandy island complex known as the Lake of the Woods Sand Spit Archipelago includes the Sable Islands, Ontario, as well as Pine and Curry islands, Minnesota. Morris Point and Rocky Point, on the southern shore of Lake of the Woods, are also used by Piping Plovers. In 1990, the entire area, including sites in both the U.S.A. and Canada, supported 20 adult Piping Plovers, few of which were in Canada (Maxson and Haws 1990, Heyens 1990). The Lake of the Woods population in Minnestoa has declined by over 50% from the 47-50 adults recorded in 1984 (Maxson and Haws 1990). Lake of the Woods qualifies as an Endangered Species site, if both U.S.A. and Canadian shorelines are included.]

3. Presqu'ile Provincial Park (Regional)

The long beach and point at this site provide sandy and muddy habitats that can be heavily used by shorebirds, especially when beds of washed up algae accumulate along the lakeshore. Numbers occurring in the park generally range into the hundreds for the more common species (McRae 1982, 1986), although large concentrations can occur when birds are forced down by poor weather. High counts include 5,950 and 7,000 Dunlin in 1983 and 1985, respectively (Appendix 4). McRae (1986) reported that as many as 20,000 shorebirds have been found during northward migration after the birds have been grounded by adverse weather, and considers (pers. comm.) that this many may use the area during the course of a year.

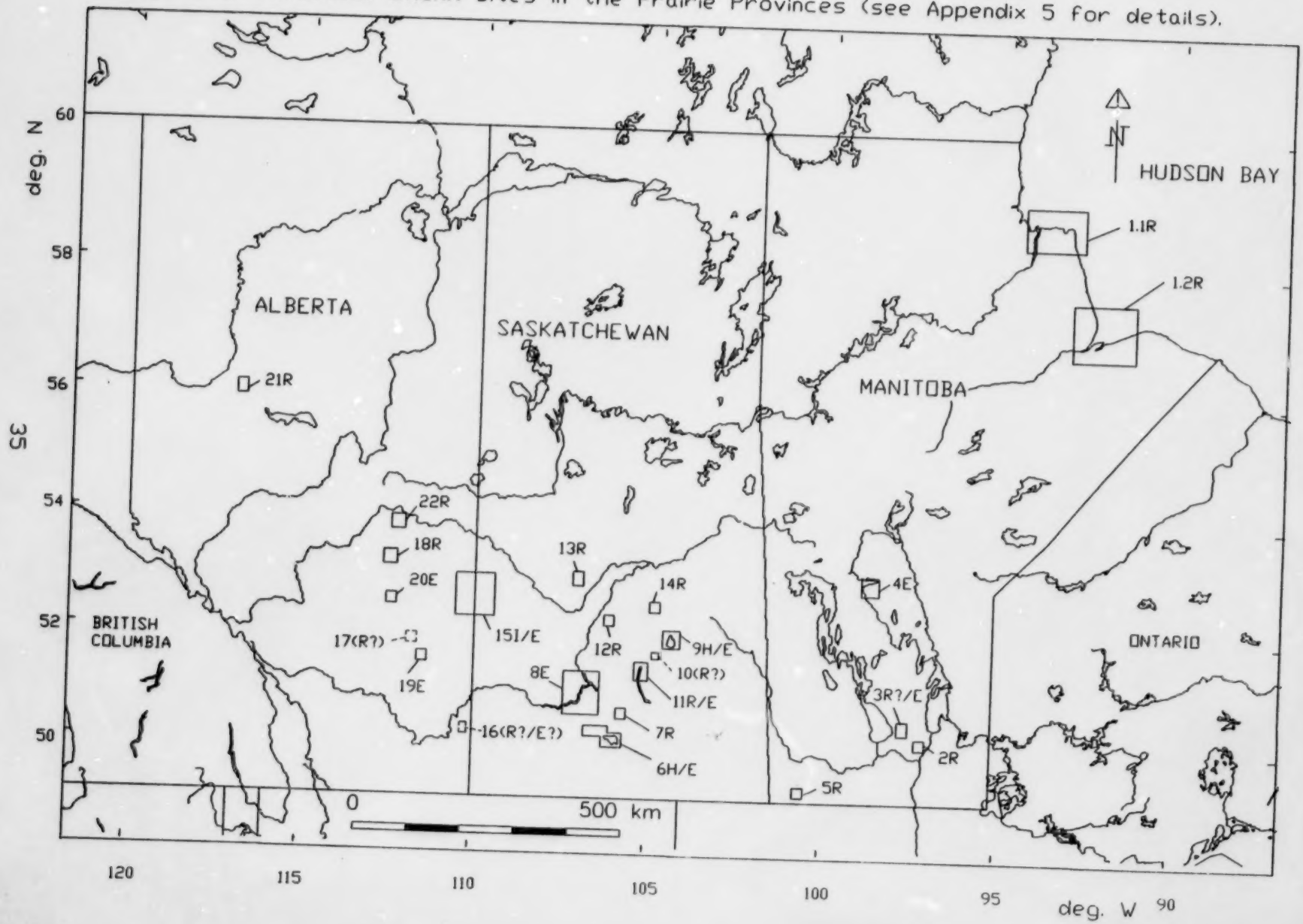
[4. Western End of Lake Ontario (Regional ?)

A complex of sites around Hamilton, including Dundas Marsh, the Windermere Basin, the Smithville Sewage Ponds, and sections of the lakeshore have been estimated to support over 20,000 shorebirds during the course of the year (Clarke 1988, ISS counts), though numbers at the individual sites do not reach levels to satisfy WHSRN criteria. The heavily polluted nature of parts of this area make its designation as a reserve questionable.]

PRAIRIE PROVINCES

Staging sites used by shorebirds in the Prairie Provinces (Figure 5, Appendix 5) are fundamentally different from those in other parts of Canada. Most are situated on shallow saline or alkaline lakes where water levels and conditions can vary considerably from year to year. With habitat availability depending heavily on water levels and the amount and type of shoreline available, shorebirds often use different lakes in different years. It is therefore more realistic to group complexes of lakes or habitats in the same geographic area into one unit when considering how potential WHSRN reserves should be identified (Appendix 5). The small saline sloughs and potholes of Prairie Canada typically all support small numbers (10-1,000) shorebirds during migration each year, and while individual concentrations are small, the overall numbers involved are undoubtedly very large.

Figure 5. Potential WHSRN sites in the Prairie Provinces (see Appendix 5 for details).



1. Hudson Bay coast of Manitoba (Regional/International?)

Churchill, Man. (Regional/International?)

Nelson River/Hayes River area, Hudson Bay, Man. (Regional)

Churchill is well known as a breeding area for shorebirds, but large concentrations of migrants have also been recorded along the adjacent coast of Hudson Bay. One of the most significant observations was of some 6,000 Ruddy Turnstones (Appendix 5) (Gollop 1982): this is the largest concentration of this species recorded to date in Canada, and represents some 6% of the highest number yet observed in North America (an estimated 90,000-106,000 on spring migration in Delaware Bay (Dunne et al. 1982)).

Surveys of the Hudson Bay coast between Churchill and the Manitoba/Ontario Border during spring and autumn migration in 1974 produced totals of 10,750 and 16,165 shorebirds, respectively, of which 50-60% were found in the vicinity of the Hayes and Nelson rivers (R.I.G. Morrison unpubl. data). Spring totals included an estimated 3,500+ Red Knots, and Hudsonian Godwits were numerous (hundreds) in the area.

2. Oak Hammock Marsh, Winnipeg, Man. (Regional)

The Oak Hammock Marsh Wildlife Management area consists of some 3,600 hectares of managed fresh water marsh and upland habitat. When water conditions are suitable, large numbers of a variety of shorebird species are attracted to the area. Concentrations are greatest in spring, and combined maximum count totals from different areas of the complex reached nearly 30,000 shorebirds (Appendix 5). The marsh supported significant percentages of the totals of wintering shorebirds counted on the coast of South America by Morrison and Ross (1989) for White-rumped Sandpipers, Short-billed Dowitchers, Hudsonian Godwits and yellowlegs (Appendix 5).

3. Shoal Lakes, Man. (Regional?/Endangered)

The Shoal Lakes, located northwest of Winnipeg, are comprised of three main waterbodies (North, East and West Shoal Lake), which are remnants of what was, until drained in 1912, a single lake. All are essentially catchment basins, surrounded by crown land used for grazing. The low relief and fluctuating water levels allow mudflats and shallow water areas to exist at all times. West Shoal Lake supports a small but significant number of Piping Plovers. In 1990, 36 adults were found during May surveys and 64 in July (Koonz 1990). The July count

represents about 2% of the North American Northern Great Plains population. In 1985, about 80 plovers were counted during July surveys (Haig 1987, representing about 3% of the North American Northern Great Plains population). These lakes should be included in WHSRN under the Endangered Species category as they form the second most important site for Piping Plovers in Manitoba. The lakes also support staging shorebirds, with single day counts of approximately 3,000 and 380 in the spring and fall of 1987, respectively (Appendix 5). Additional data are required on numbers and turnover rates.

4. Gull Bay, Lake Winnipeg, Man. (Endangered)

This area, which includes approximately 15 kilometres of sandy beach, may be the primary Piping Plover breeding site in Manitoba, with 47 adults reported in late May 1989 (Koonz 1989) and 50 adults on 10 July 1990 (Koonz 1990); the latter count represents about 2% of the North American Northern Great Plains population. The large number of plovers in July may indicate that the area is also an important staging area for Piping Plovers. Many other species of shorebirds use the Gull Bay sandspit during migration (A. Houle, pers. comm., W. Koonz pers. comm.). One of the spits has recently been designated as the Walter Cook Special Conservation Area.

5. Whitewater Lake, Man. (Regional)

Whitewater Lake is the catchment basin receiving water from Turtle Mountain in southwestern Manitoba. The lake covers approximately 6,070 hectares (15,000 acres) at an average depth of 76 cm (2.5 feet). Increased water run-off may result in depths averaging some 37 cm (1.2 feet) more, when the lake covers some 10,320 hectares (25,500 acres) (Ransome and Hochbaum 1972). In recent years, however, the lake has had extremely shallow water owing to persistent drought conditions, and it went dry in both 1988 and 1989. The potential of the lake for providing shallow water and extensive mudflats during drought conditions makes it particularly important in the eastern Prairies. Aerial surveys in 1987 produced a maximum count of 23,070 shorebirds (Dickson and Smith 1988, Smith and Dickson 1989), and some 10,000 White-rumped Sandpipers were found during International Shorebird Surveys in 1988 (Appendix 5).

6. Old Wives Lake/Chaplin Lake/Reed Lake, Sask. (Hemispheric/Endangered)

6.1 Old Wives Lake/Chaplin Lake, Sask. (Hemispheric/Endangered)

6.2 Reed Lake, Sask. (Regional ?)

Chaplin Lake and Old Wives Lake are large intermittent saline lakes covering some 6,360 and 33,020 hectares, respectively (Dickson and Smith 1988). Chaplin Lake is broken into a number of sections by a series of dykes and roads built during the operation of a salt mine on its north shore.

During aerial surveys in the spring of 1987, 64,400 shorebirds were seen on Chaplin Lake and a further 59,800 on Old Wives Lake, some 15 km to the southeast. These were by far the largest numbers of migrant shorebirds found during the surveys of the Prairies (Dickson and Smith 1988). Extrapolation from the species composition obtained from ground surveys indicated that 51,700 of the combined lakes total of 124,200 were Sanderling, representing some 46% of the South American coastal wintering total recorded for this species by Morrison and Ross (1989). The lake also supported the highest recorded concentration to date of Baird's Sandpipers in Canada (29,900). Notable numbers of Piping Plovers and Semipalmated Sandpipers were also found in the area

(Appendix 5). In 1984, a total of 292 Piping Plovers was counted at Old Wives Lake and Chaplin Lake (Harris et al. 1985), representing 11% of the North American Northern Great Plains population. Reed Lake, a narrow, shallow lake running along the Trans Canada Highway, also supports moderate though variable numbers of shorebirds, which are undoubtedly linked to the populations staging at Chaplin Lake/Old Wives Lake.

7. Pelican Lake, Sask. (Regional)

Although Pelican Lake held only 1,000 shorebirds during aerial surveys in May 1987 (Dickson and Smith 1988), the lake was earlier reported to support some 75,000 shorebirds during spring migration and up to 1,000 Marbled Godwits during autumn migration in 1978 (Serr 1978).

8. Lake Diefenbaker, Sask. (Endangered)

The shorelines of the artificial Lake Diefenbaker support significant numbers of the Great Plains population of Piping Plovers (Appendix 5). A maximum count of 223 Piping Plovers was reported in 1984 by Harris et al. (1985), which represents 8.4% of the Great Plains population of 2,652 individuals reported by Haig et al. (1988). The water level of this freshwater,

artificial lake is controlled by the Qu'appelle and Gardiner dams, and is largely dependent on snowmelt in the Rocky Mountains to the west. The lake may thus be full of water even during drought years on the Prairies. Specific management is required to ensure water levels are not raised on the lake during the nesting season to such an extent that Piping Plover nests and/or young are destroyed. Recommendations have been made to the Inland Waters Directorate, Environment Canada, on ways to manage water levels in Lake Diefenbaker to benefit Piping Plover habitats around the lake.

9. Quill Lakes, Sask. (Hemispheric/Endangered)

The Quill Lakes, which were designated as a Ramsar site in 1982, consist of a complex of three lakes. Big Quill Lake is roughly pear-shaped, measuring about 27 km long and 18 km at its widest point; to the east lie Middle Quill Lake, which is about 6 km long and 3 km wide, and Little Quill Lake, some 24 km long by 11 km in width. Salinity levels are variable, differing both between lakes and varying with the water level in the lake.

Both Big Quill and Little Quill lakes have shallow shorelines of muddy or sandy alkaline flats. Middle Quill Lake tends to be deeper, but in drought years also provides excellent mudflats and shallow water for staging and breeding shorebirds.

The north and east shores of Big Quill Lake are very shallow. Renaud (1979) reported that the shoreline retreated 1-5 km between 1909, when Ferry (1910) visited the area, and 1978, resulting in the exposure of extensive, sparsely vegetated alkaline flats. These areas are important breeding sites for Piping Plovers (Renaud 1979), and large numbers of shorebirds may occur during migration. Similar conditions occur on the west side of Big Quill Lake and on Middle Quill Lake. The south shore of Big Quill Lake and north shore of Little Quill Lake have fewer beaches or alkaline flats suitable for large concentrations of staging shorebirds. Adjacent marshy wetlands are also extremely important for migrating shorebirds, especially at night when they use such habitats for roosting.

International Shorebird Survey operations in 1988 resulted in a total of 155,000 shorebirds being counted on Big Quill Lake, including an estimated 23,500 Sanderling, which represents some 24% of the South American coastal wintering population counted by Morrison and Ross (1989) (Appendix 5). Surveys on Middle and Little Quill lakes in 1989 resulted in a further 59,900 shorebirds being counted, producing a combined maximum count total for the Quill Lakes of 214,900 for the two years. Significant numbers of several other species were also recorded, including Hudsonian Godwit, Marbled Godwit, Red Knot, Stilt Sandpiper, yellowlegs, Least Sandpiper, Long-billed Dowitcher, Red-necked Phalarope and Piping Plover. Big Quill Lake is one of

the most important breeding sites in North America for Piping Plovers, with 298 adults accounted for in 1984 (Harris and Lamont 1985), representing about 11% of the North American Great Plains population.

[10. Kutawagon Lakes, Sask. (Regional ?)

The Kutawagon Lakes, a chain-like series of small, shallow, saline lakes, lie to the southwest of the Quill Lakes, and supported over 12,000 shorebirds during CWS aerial surveys of the area in spring 1988 (Appendix 5).]

11. Last Mountain Lake (north end), Sask. (Regional/Endangered)

Southwest of Kutawagon Lakes lies the northern end of Last Mountain Lake, Canada's first Migratory Bird Sanctuary and a designated Ramsar site. The shallow lakeshore and adjacent basins provide a variety of habitats, both natural and managed, including mudflats and marshland. Shorebird surveys have produced counts of around 5,000 birds, with occasional large concentrations of Red Knots and Ruddy Turnstones (Appendix 5). Lahrman (1972) reported over 2,500 Red Knots near Last Mountain Lake on 21 May 1972 in a burned-over stubble field, with a similar number of Ruddy Turnstones. Forty-three Piping Plovers were reported on Last Mountain Lake in 1984 (Harris et al. 1985),

10 of which were in the protected areas at the north end of the lake.

12. Burke/Porter/Buffer lakes area, Sask. (International)

12.1 Burke Lake/Porter Lake, Sask. (International)

12.2 Buffer Lake, Sask. (Regional ?)

Several reports of substantial numbers (up to approximately 2,000) of Hudsonian Godwits at Porter Lake (Appendix 5) indicate this area could be considered as an International Reserve for the population of this species wintering on the Pacific coast of South America. A single day count of approximately 11,000 staging shorebirds was recorded at Buffer Lake in 1987 (Appendix 5).

13. Blaine Lakes, Sask. (Regional)

Blaine Lakes, located 70 km north of Saskatoon, are a group of shallow, intermittent saline water bodies. Maximum survey counts of almost 30,000 shorebirds during spring migration in 1989 indicate that the lakes qualify for Regional Reserve status (Appendix 5).

14. Lac Lenore/Basin Lake, Sask. (Regional)

14.1 Lac Lenore, Sask. (Regional)

14.2 Middle Lake/Basin Lake, Sask. (Regional ?)

Lac Lenore supported over 20,000 shorebirds during spring surveys within the boundaries of the Lenore Lake Migratory Bird Sanctuary in 1989, while Middle and Basin lakes, which are also Migratory Bird Sanctuaries, supported in the order of 13,000 staging shorebirds (Appendix 5).

15. Alberta/Saskatchewan border region (Hemispheric/Endangered)

15.1 Cipher Lake, Alta (Regional ?)

15.2 Gillespie Lake area, Alta (Regional ?)

15.3 Gooseberry Lake, Alta (Regional ?)

15.4 Killarney Lake/Leane Lake, Alta (Regional)

15.5 Killsquaw Lake, Sask (Regional ?)

15.6 Landis Lake, Sask (Regional)

15.7 Manito/Wells Lakes, Sask
(Regional/Endangered (Manito L.))

15.8 "Metiskow Lake", Alta (Regional ?)

15.9 Muddy Lake, Sask (Regional ?)

15.10 Opuntia Lake, Sask (Regional ?)

15.11 Reflex Lakes, Alta (International/Endangered)

15.12 Sounding Lakes, Alta (Regional/Endangered)

A complex of some 12 major lakes and numerous small wetlands clustered on the Alberta/Saskatchewan border supports highly significant numbers of shorebirds. Maximum counts of shorebirds recorded at the lakes listed above total some 150,000, indicating the area is likely of Hemispheric Reserve status when turnover is taken into account (Appendix 5). Individually, one lake qualifies for International status, four for Regional status and the remaining seven for possible Regional (?) status. Since Piping Plovers have been reported for all sites listed under the Alberta/Saskatchewan border region (Harris et al. 1985, Wershler

and Wallis 1987, Wershler 1989, unpubl. results, Renaud et al. 1979, Smith 1987) except Wells Lake (Harris et al. 1985) and Leane Lake (C. Wershler pers. comm.), and since evidence of breeding has been found at all but four of the sites listed, the region may also be considered an Endangered Species site.

The Reflex Lakes, straddling the Alberta/Saskatchewan border, supported a maximum of 35,950 shorebirds during CWS ground surveys in spring 1989. This total included some 20,000 Sanderlings, which represent approximately 20% of the South American Pacific coast wintering population recorded by Morrison and Ross (1989). The western-most Reflex lake had the second highest count of Piping Plovers in Alberta in 1986, with at least 46 adults reported by Wershler and Wallis (1987), representing about 2% of the North American Great Plains population. A few kilometres to the east lie the Manito/Wells lakes, where maximum numbers in spring 1989 reached 36,850 shorebirds, most of which (34,250) were Red-necked Phalaropes (Appendix 5). The Sounding Lakes, Alta, had the highest recorded maximum count (55,800) amongst the remaining areas, and was important for yellowlegs. The two remaining areas supporting over 20,000 shorebirds were Killarney Lake/Leane Lake, Alta, (27,500) and Landis Lake, Sask, (24,800); at both lakes, the majority of the birds recorded were Red-necked Phalaropes (20,000 and 11,900, respectively).

The remaining seven lakes supported a maximum count total of

67,700 birds, with individual totals ranging from 5,800 to 17,700 (Appendix 5). The lake with the highest total, "Metiskow Lake", Alta, (17,703), supported the second highest concentration of Baird's Sandpipers recorded on the surveys. Gillespie Lake, Alta, (16,850) supported notable numbers of Stilt Sandpipers (10,000) and Gooseberry Lake, Alta, significant numbers of Red-necked Phalaropes (10,000) (Appendix 5).

Other lakes which could be included in this complex are Corin, Cactus, Teo and Gull lakes, Saskatchewan, and Grassy Island Lake, Alberta.

16. Chappice Lake, Alta. (Regional ?/Endangered?)

A maximum count of 11,000, including 4,500 Sanderling, indicate this site should be considered as a possible Regional reserve. Piping Plovers breed at the lake; a maximum count of 17 adults was recorded in 1986 (Wershler and Wallis 1987).

[17. Sullivan Lake, Alta. (Regional ?)

This large lake in central Alberta possesses extensive areas of mudflats and/or extremely shallow water. Over 14,000 shorebirds were recorded on the lake during ground surveys in

1989, and the area would presumably qualify as a Regional Reserve when turnover is taken into account.]

18. Beaverhill Lake, Alta. (Regional)

Beaverhill Lake, some 65 km east of Edmonton, is a large, shallow lake measuring about 16 km by 12 km; it functions as the collection basin for the run-off from the higher Beaver Hills lying to the west (Decker 1982, Smith and Weseloh 1982). Lake levels have varied considerably during the present century, reaching a low in the 1950s. The shoreline is rather variable, with narrow sandy beaches in the south, muddy shorelines with deeply indented reed-choked bays and rocky points in the north, willow and poplar shrubs along the east and south, and open rough pastures and gently sloping fields along the west and north shores (Decker 1982). Grazing maintains the adjacent open grassland areas, and changing water levels are important in the long term control of the amount of flats and vegetation around the margin of the lake.

Beaverhill Lake regularly supports substantial numbers of a variety of shorebirds and qualifies for Regional reserve status. The maximum count reported from the area was 23,442 during spring surveys in 1989 (Appendix 5). Notable concentrations of individual species have included up to 10,000 Red-necked

Phalaropes in 1986 (International Shorebird Surveys) and 10,000+ Pectoral Sandpipers, 1,100 White-rumped Sandpipers and 1,500 Buff-breasted Sandpipers in 1978 (Decker 1982). Counts of up to several hundred Red Knots, Ruddy Turnstones and Black-bellied Plovers have also been made at the lake (Appendix 5).

19. Hanna area, Alta. (Endangered)

19.1 Chain Lakes, Alta. (Endangered)

19.2 Dowling Lake, Alta. (Endangered)

19.3 Handhills Lake, Alta. (Endangered)

19.4 Little Fish Lake, Alta. (Endangered)

19.5 Spiers Lake, Alta. (Endangered)

About 125 Piping Plovers have been recorded at the above five lakes, representing some 42-57% of the Alberta population (Wershler unpubl. data) or about 5% of the North American Northern Great Plains population (Haig et al. 1988), and breeding has been reported at all sites (Wershler and Wallis 1987, Goossen 1990, Wershler unpubl., Goossen in prep.). In recent years, Little Fish Lake has supported the highest number of Piping Plovers recorded in Alberta, with 49 observed in 1989 (Wershler 1989) and 48 in 1990 (Hofman 1990). At least 37 adults have been seen at Handhills Lake (Wershler and Wallis 1987) This lake appears to be the most productive site in Alberta, and produced

46 young during 1989-1990 (Goossen 1990, in prep.). Fourteen adults have been reported at Chain Lakes (Wershler and Wallis 1987, seven at Spiers Lake (Shandruk and Fortin in prep.) and 18 at Dowling Lake (Wershler and Wallis 1987).

Over 1,000 shorebirds were seen on the lakes during aerial survey in May 1987 (Smith and Dickson 1989).

20. Rockland Bay/"Rider Lake", Alta. (Endangered)

During 1989 and 1990, at least 47 adult Piping Plovers were found at this site (Goossen 1990, in prep.), representing some 16-21% of the Alberta population or about 2% of the North American Northern Great Plains population. Thirty-four young were found during surveys in 1989 and 1990 (Goossen 1990, in prep.).

21. Kimiwan Lake, Alta. (Regional)

Kimiwan Lake is the most northerly of the potential WHSRN reserve sites currently identified on the Prairies, and is located about 135 km northeast of Grand Prairie. Two counts of over 20,000 shorebirds were recorded during CWS surveys in 1988, with significant numbers of dowitchers, mostly Long-billed

Dowitchers (12,000), and Pectoral Sandpipers (7,000) (Appendix 5).

22. Whitford Lake, Alta. (Regional)

Whitford Lake, located approximately 75 km northeast of Edmonton, is the most recent addition to potential Prairie WHSRN sites. Over 20,000 shorebirds were seen on the lake in May 1991 (E. Eroschuk pers. comm.).

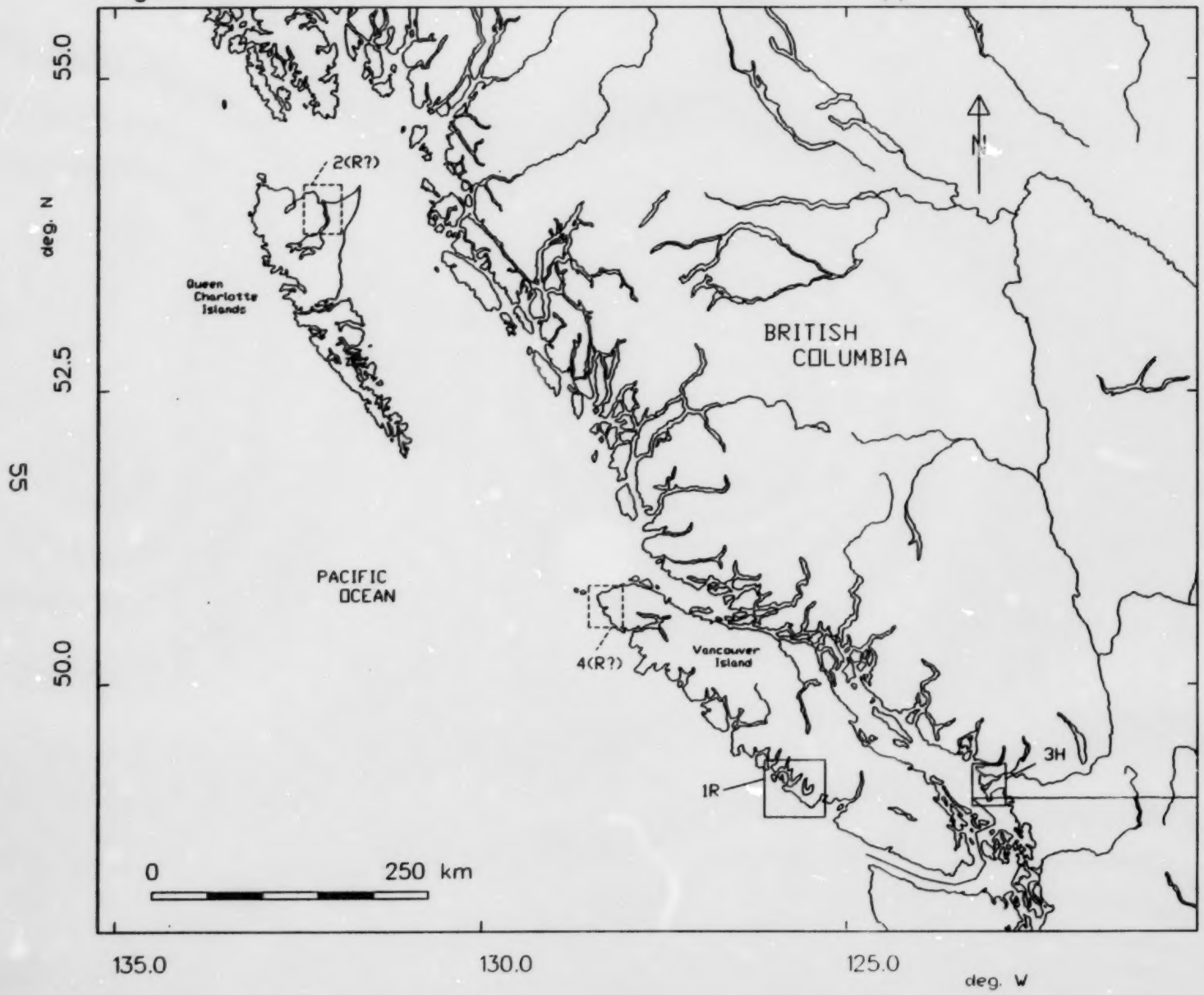
PACIFIC CANADA

Potential WHSRN sites in Pacific Canada are shown in Figure 6 (see Appendix 6 for details). Distances between the major staging areas used by calidrid shorebirds on the Fraser River delta in southern British Columbia (Butler and Kaiser 1988) and the Stikine River, Alaska, and the Gulf of Alaska (Senner et al. 1981) are some 800 and 1,200 km, respectively. There is no known site that supports comparable numbers of shorebirds along the mainly mountainous coast between these staging areas, and the Fraser River is clearly an important refuelling stop for birds on migration. Studies of Western Sandpipers at Sidney Island, about 30 km southwest of the Fraser River delta, suggested a 2-3 day turnover rate (Butler et al. 1987), inferring that the total number of birds using the area is much higher than daily counts alone would indicate.

1. Tofino Flats/Chesterman Beach, Vancouver Island, BC (Regional/International ?)

Chesterman Beach is located just to the south of the Tofino Flats on the west coast of Vancouver Island. Peak counts of Western Sandpipers recorded at these sites (16,000 in May 1988 and 23,000 in August 1989 at Tofino (Butler et al. 1991) and an average autumn peak of 35,000 at Chesterman Beach (Butler and

Figure 6. Potential WHSRN sites in Pacific Canada (see Appendix 6 for details).



Kaiser 1988)), are amongst the highest recorded on the west coast of Canada and account for a significant proportion of the west coast total (Appendix 6).

[2. Delkatla Slough, Queen Charlotte Islands, BC (Regional ?)

Delkatla Slough, near the northern end of the Queen Charlotte Islands, provides the only known significant shorebird habitat between southern British Columbia and Alaska. Peak counts of Western Sandpipers are quite low and the frequency of use is unknown. A high turnover rate would imply the site supports enough birds to qualify as a regional reserve (Appendix 6).]

3. Fraser River delta, BC (Hemispheric)

The Fraser River delta is the largest estuary on the Pacific coast of Canada, containing some 20,000 hectares of mudflats and sandflats and 1,500 hectares of marsh (Butler et al. 1987). The delta forms a vital link in the chain of bird habitats extending from breeding grounds in the eastern USSR, Alaska and northern Canada to wintering grounds in the southern USA and Central and South America (Butler and Campbell 1987). It is important both as a staging site for Western Sandpipers and as a wintering area

for Dunlins and Black-bellied Plovers. Monthly counts made throughout the year indicate that the area supports over 1.5 million waterbirds, including some 607,000 shorebirds (Butler and Cannings 1989). Spring and autumn maximum counts of Dunlin reached 126,000 and 97,000, respectively, in 1989 (Butler and Cannings 1989), and winter populations have averaged about 40,000 (Fry 1980, Butler and Campbell 1987). Western Sandpipers reached a peak of 100,000 birds in April and 55,000 in August in 1990 (Butler unpubl. data). Estimates of the total numbers of Western Sandpipers using the area based on the high turnover rates found at Sidney Island (Butler et al. 1987) indicate that as many as 500,000 and 1.2 million Western Sandpipers may use the area in spring and autumn, respectively (Butler and Campbell 1987, Butler and Kaiser 1988). Further study of the exceptionally high turnover rate is needed. Least Sandpipers are also thought to use the delta in significant numbers, although the peak recorded counts (maximum 2,000) are not large; mist net catches indicate a Least Sandpiper:Western Sandpiper ratio of 1:10 (Butler and Campbell 1987).

[4. Hansen's Lagoon, BC (Regional ?)

Hansen's Lagoon is situated near the northern tip of Vancouver Island and supports small numbers of Western Sandpipers (Appendix 6).]

Discussion

The four sites identified as potential Hemispheric Reserves in Canada vary considerably in nature and in the species of shorebirds for which they are important. All include extensive mudflats or marshes with high biological productivity.

In the Maritime Provinces, the two upper arms of the Bay of Fundy form the focal point for the migration of Semipalmated Sandpipers on the east coast of North America (Morrison and Harrington 1979), and are also important for a wide range of other species (Hicklin 1987). The exceptionally large tidal ranges have led to the development of very extensive intertidal mud and sand flats, which support abundant invertebrate populations used by the birds for food. Suitable roosting sites occur on adjacent beaches. Shepody Bay and Minas Basin were dedicated as elements of the Bay of Fundy Western Hemisphere Shorebird Reserve in 1987 and 1988, respectively (Hicklin 1988a, 1988b).

A second possible Hemispheric reserve on the east coast involves a marine site in Passamaquoddy Bay near the mouth of the Bay of Fundy, where the turbulent tidal currents produce areas of heavy upwelling. Between 500,000 and 2,000,000 Red-necked Phalaropes were reported to use the area during autumn migration in the 1970s and early 1980s. In recent years, however, very few

phalaropes have been found in the area. Preliminary investigations (R.G.B. Brown unpubl.) have indicated that the Euphausid shrimps which formed the main food of the phalaropes no longer occur near the water surface, but the factors which have resulted in this change are not clearly understood. This situation does, however, emphasize the need for ongoing monitoring of sites to detect shifts in distribution of birds and/or their prey, and the necessity for flexibility in adjusting and updating the status of reserves in response to such changes.

Flat topography and moderate tidal ranges have produced extensive intertidal flats and associated marshes on the west coast of James Bay, Ontario. These habitats form a natural migration corridor bordered by the waters of the bay to the east and the vast inland muskeg to the west. The area is particularly important for Red Knots and Hudsonian Godwits, but supports a wide range of other species, including Semipalmated Sandpiper, yellowlegs, White-rumped Sandpiper and Dunlin. Similar habitats occur along the southwest coast of Hudson Bay, and important shorebird habitats are found north to Churchill, Manitoba.

Shorebird sites on the Prairies are mostly found on large shallow saline or alkaline lakes, where water levels vary considerably from year to year. When intermediate water levels occur, extensive mudflats may develop and attract large concentrations of shorebirds. Prairies sites are important in

both spring and fall, but especially so in spring when many species migrate northwards through the interior of the continent (Morrison 1984). Little information is available on the long-term variability in habitat conditions and shorebird use at a given site from year to year, but such variability will be an important factor in designing an effective reserve system for interior sites. Prairies sites are important for Sanderling, Red-necked Phalarope, Baird's Sandpiper, Semipalmated Sandpiper, Red Knot, Ruddy Turnstone, Stilt Sandpiper, dowitchers, Hudsonian Godwit, Black-bellied Plover, Pectoral Sandpiper and Piping Plover.

In the lower Fraser River delta, large intertidal areas with abundant invertebrate food resources support large populations of migrant and wintering shorebirds (Butler and Campbell 1987). About 60,000 Dunlins and 2,000 Black-bellied Plovers remain throughout the winter. A flag-marked Western Sandpiper banded in Panama was seen near Tofino (Butler et al. 1991), suggesting Tofino forms a link in the chain of sites used by migrants moving along the Pacific coast to Alaska. Flag- and colour-marked Western Sandpipers banded in the Fraser River delta have been found in Kansas (Senner and Martinez 1982), suggesting a cross-continent route. Semipalmated Sandpipers banded in Saskatchewan have been seen in the Fraser River Delta (CWS unpubl. data).

Since its establishment as a conservational organisation,

the Western Hemisphere Shorebird Reserve Network has designated some 17 reserves in countries throughout the western hemisphere, including Canada, U.S.A., Suriname, Brasil, Argentina and Peru. The majority of sites designated to date have been Hemispheric or International, and have covered some 4 million wetland acres and provided protection for an estimated 30 million shorebirds (MBO 1991). The present document is intended as a first inventory of currently known sites meeting WHSRN criteria in Canada for use in planning the future development of the network. As yet, no sites have been designated under the Endangered Species category: such sites often involve small numbers of birds compared with other categories and/or relatively specialized habitats. Canada holds some 36% of the western hemisphere population of Piping Plover and the development of a network of sites protecting key breeding areas on the Prairies and in the Maritime Provinces should be given consideration (Goosen 1990).

Estimates of populations

The criteria used to assign sites to the various reserve categories are based on: (1) the number of birds which the site supports during the course of the year or, (2) the percentage of a species flyway population using the site. The only unequivocal case will occur where the sum of the maximum (single day) counts of the different species using the area, or single count of one

species using the area, exceeds the minimum figure. Examples include counts of Semipalmated Sandpipers in the upper Bay of Fundy and on the wintering grounds in Suriname, both of which have exceeded the 500,000 criterion for a Hemispheric Reserve (Hicklin 1987, Morrison and Ross 1989). The total number of birds using a site will clearly be higher than the maximum single day count, since turnover will occur during migration. Few studies, however, have yet been made on the rate of turnover at different sites, and on the relationship between the peak number observed and the total estimated to be using the site. Studies on Semipalmated Sandpipers in the Bay of Fundy and on Western Sandpipers on the west coast have produced very different estimates of these parameters. Hicklin (1987 and unpublished results) has estimated that the length of stay of Semipalmated Sandpipers in the Bay of Fundy is approximately 10-15 days, and that the ratio between the total using the site and the peak count varied between about 1.25 and 2.00. On the west coast, Butler et al. (1987) estimated from studies of marked individuals that the average length of stay of Western Sandpipers was 1-3 days, and that the ratio between the population estimate for the site and the average peak number was about 27 (Butler and Kaiser 1988). Such large differences suggest that turnover rates vary between species and possibly between sites. Site-specific estimates of turnover rates are clearly needed when calculating numbers using a particular site. Estimation of turnover rates, however, presents considerable logistical problems on large

estuaries used by major concentrations of birds and on many prairie lakes.

Future directions

It is anticipated that other sites will be identified as work on shorebirds continues across Canada. Long-term studies of between-year variability of use of sites, especially those on the Prairies, and on turnover rates are clearly needed. Continued monitoring of sites is required to identify major changes in distribution, such as those which have occurred with phalaropes on the Atlantic coast, and to track trends in population levels. Little is currently known about whether some sites may only be used by shorebirds on an occasional basis but nevertheless play a critical role in the long term survival of the population.

Little is known concerning the locations of key breeding areas in the arctic, where the birds are more dispersed. Criteria are needed for the identification of such areas for inclusion in the WHSRN, to enable completion of conservational protection of the key sites used by the birds throughout their ranges.

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Appendix 1. Definitions and abbreviations for terms, and scientific names and abbreviations for species used in this document.

WHSRN site categories
H = Hemispheric
I = International
R = Regional
E = Endangered Species
? indicates site does not qualify directly from count data, but may qualify when turnover is taken into account

Species abbreviations

AMAV	American Avocet	Recurvirostra americana
BASA	Baird's Sandpiper	Calidris bairdii
BBPL	Black-bellied Plover	Pluvialis squatarola
BBSA	Buff-breasted Sandpiper	Tryngites subruficollis
DOWI	dowitchers	Limnodromus spp.
DUNL	Dunlin	Calidris alpina
HUGO	Hudsonian Godwit	Limosa haemastica
LBDO	Long-billed Dowitcher	Limnodromus scolopaceus
LESA	Least Sandpiper	Calidris minutilla
LEYE	Lesser Yellowlegs	Tringa flavipes
MAGO	Marbled Godwit	Limosa fedoa
PESA	Pectoral Sandpiper	Calidris melanotos
PIPL	Piping Plover	Charadrius melodus
PUSA	Purple Sandpiper	Calidris maritima
REKN	Red Knot	Calidris canutus
REPH	Red Phalarope	Phalaropus fulicaria
RNPH	Red-necked Phalarope	Phalaropus lobatus
RUTU	Ruddy Turnstone	Arenaria interpres
SAND	Sanderling	Calidris alba
SBDO	Short-billed Dowitcher	Limnodromus griseus
SEPL	Semipalmated Plover	Charadrius semipalmatus
SESA	Semipalmated Sandpiper	Calidris pusilla
SLSA	Stilt Sandpiper	Calidris himantopus
WESA	Western Sandpiper	Calidris mauri
WHIM	Whimbrel	Numenius phaeopus
WIPH	Wilson's Phalarope	Phalaropus tricolor
WRSA	White-rumped Sandpiper	Calidris fuscicollis
YELL	yellowlegs	Tringa spp.
peeps	refers to small sandpipers and plovers	
-	Greater Snow Goose	Anser caerulescens

Other abbreviations

CWS	Canadian Wildlife Service
ISS	International Shorebird Survey
MSS	Maritimes Shorebird Survey
WHSRN	Western Hemisphere Shorebird Reserve Network

Appendix 2. Potential WHSRN sites in Atlantic Canada

Location	Type	Shorebird numbers	References, comments
1. Upper Bay of Fundy, NB/NS	H		
1.1 Cumberland Basin, NB/NS	R	SESA 30,000 (1978)	Minudie, NS (MSS)
1.2 Shepody Bay, NB	H	* SESA max. counts: 80,000-300,000 (1974-1986)	Mary's Point, NB MSS
		350,000 (1977)	(Hicklin 1987)
		- 20,000 peeps (1978)	Daniel's Flats, NB MSS
		- SESA max. counts 30,000-72,000 (1975-79)	Grande Anse, NB MSS
			Shepody Bay dedicated as part of Bay of Fundy Western Hemisphere Shorebird Reserve August 1987
1.3 Cobequid Bay, NS	R	- max. count 10,087 (1982)	Black Rock, NS MSS
		- max. count 6,908 (1978)	Moose Brook, NS MSS
		- max. counts 7,444-15,099 (1976-1979)	Noel Bay, NS MSS
		- max. 11,030 (1976)	Noel Shore, NS MSS

Appendix 2 (continued).

1.4 Minas Basin, NS	H	- max. counts: 16,000-25,000 (1974-1978)	Evangeline Beach, NS MSS
		40,000	Hicklin (1987)
		- max. count 25,156 (1975)	Grande Pre, NS MSS
		- max. count 27,703 (1976)	Kingsport to Oak Island, NS MSS
		- max. 13,645 (1979)	Oak Island East, NS MSS
2. Grand Manan area, NB	I?	* max. count 100,000 phalaropes (1979)	Kent Island (MSS)
		* 100,000 phalaropes (1980)	off Gannet Rock (MSS)
		- 15,000 phalaropes (1978 MSS)	Castalia Marsh (MSS)
3. Maces Bay, NB	R?	max. counts: 8,395 (1975); 13,797 (1976); 5,361 (1977)	(MSS)
		PUSA 525+ (1974)	(CWS aerial survey)
4. Quaco Bay, NB	R?	max. count 8,740 (1974)	(MSS)
5. Quoddy Region, NB	H?	RNPH min./max. 35,000-770,000 (1981-82); up to 1 million (1980); at least 2 million (1977); only 15,000+ (1978); c. 100,000 (1971)	Mercier & Gaskin (1985), Vickery (1978, 1979, 1981), Finch (1972); Recent surveys indicate that large numbers of phalaropes no longer use this area
6. Saints Rest marsh and beach, St. John, NB	R(I?)	max. 111,543 (1986); SESA 20,000 (1976); peeps 23,000 (1985)	(MSS)

Appendix 2 (continued).

7. Brier Island, NS	R	REPH 20,000	Vickery (1979); phalarope numbers may have declined in recent years
8. Cape Sable, NS	R?	max. counts (1977-1984): 6,520-10,830	MSS
9. Cook's Beach, NS	R?	max. counts: 8,620 (1983); 7,899 (1982)	MSS
10. Maritimes Piping Plover Sites, NB, PEI, NS	E?	approx. 200 pr. all sites	CWS unpubl.
10.1 Eastern New Brunswick			
10.2 Northern Prince Edward Island			
10.3 Southern Nova Scotia			

Appendix 3. Potential WHSRN sites in Quebec.

Location	Type	Shorebird numbers	References, comments
1. Saguenay River Area	R		
1.1 Battures aux Allouettes	R?	- max. 5,500 (1988), 8,632 (1989): SESA 4,000 DUNL 2,000 BBPL 600 REKN 1,600 SAND 2800 RUTU 200	CWS surveys, Bourget (1988, 1989, 1990, 1991)
1.2 Ile Rouge	R?	- max. 13,401 (1981) BBPL 10,000 SESA 2,500 RUTU 980	(Maisonneuve 1982)
1.3 Ile Blanche	R?	- max. 7,020 (1989)	CWS
2. Banc de Portneuf	R?	- max. 14,770 (1990) SESA 8,600 SAND 4,000 BBPL 2,500 SEPL 300 WRSA 6,000 RUTU 100	(Maisonneuve 1982) (CWS, WHSRN)
3. Gentilly	R?	- max. 12,705 (1977) - max. 10,425 (1979) SESA 10,000 LEYE 1,500 LESA 1,000	(Brousseau 1981)

Appendix 3 (continued).

4. Iles-de-la-Madeleine	R/E	- max. 11,000 (1987) BBPL 3,000 SBDO 650 SEPL 2,500 REKN 200 SESA 3,000 RUTU 600 HUGO 150 WRSA 1,000 LESA 600 - max. peeps 37000 (1978)	MSS
		SBDO 4,000 REKN 504 SESA 9,000 HUGO 200 WRSA 6,000	Mousseau et al. (1976)
		BBPL 6,000 WRSA 10,000 SESA 12,000	Hagar (1956)
		BBPL 2,000 WRSA 880 SESA 2,400 SBDO 900+	Hagar (1949)
		PIPL 74	Shaffer and Pineau (1987)
5. Montmagny Archipelago	R		
5.1 Montmagny	R	- max. 16,700 (1989) SESA 16,700 - max. 15,848 (1980)	CWS Brousseau 1981
5.2 Battures aux Loups-marins	R	- max. 30,600 (1989) -max. 13,876 (1980) SESA 30,600 RUTU 250 SEPL 770	CWS, Brousseau (1981)
6. Minganie	R?	- max. 7,200 (1988) REKN 1,150 HUGO 130 WRSA 1,500 LESA 750 LEYE 300	CWS

Appendix 4. Potential WHSRN sites in Ontario

Location	Type	Shorebird numbers	References, comments
1. James Bay (west coast)	H/I	aerial survey totals: 60,403 (1974); 39,876 (1976/77);	
		HUGO 10,000 (1974)	>30% Atlantic coast South American wintering population (32,700)
		REKN c. 7,000 (1976), 15,000 (1990)	10-20% South American wintering population (76,392)
			(Morrison unpubl. data; Morrison and Harrington (1979); Morrison and Ross (1989, unpubl. data)
2. Lake of the Woods	E	PIPL: (1990) 4 ads. in Ontario 16 ads in Minnesota	Heyens (1990) Maxson and Haws (1990)
3. Presqu'ile Provincial Park, Lake Ontario	R?	max. spring: 7,566 (1985) incl. DUNL 7,000; 5,953 (1983) incl. DUNL 3,500, SESA 250; max. autumn: 2,126 (1984) incl. SESA 1,500, SAND 250; 1,329 (1978)	MSS/ISS data
		up to 20,000 during northward migration	McRae 1986
4. Western end of Lake Ontario	R?	max. spring 5,264; max. autumn 3,830	turnover estd. c.>20,000 (Clark 1988)

Appendix 5. Potential WHSRN sites in the Prairie Provinces.

Location	Type	Shorebird numbers	References, comments
1. Hudson Bay Coast, Man.	R/I?		
1.1 Churchill area, Hudson Bay coast	R/I?	RUTU 6,000 (5/6/82) = 6% highest North American count, or 25.5% South American coastal wintering population (23,499); 2,000+ (17/6/83)	Gollop (1982, 1983) Dunne et al. (1982) Morrison and Ross (1989)
		- important nesting area for many species, including HUGO	Hagar (1966), Skeel (1976, 1983)
1.2 Nelson River/Hayes River area, Hudson Bay coast	R	- 50-60% of Churchill to Man./Ont. border aerial survey totals 10,573 (spring) and 16,165 (autumn) in area of Hayes/Nelson rivers; includes 3,500 + REKN, many hundreds HUGO	CWS surveys

Appendix 5 (continued).

2. Oak Hammock Marsh, Man.	R	* max. 16,759 (north cell block, spring 1981), plus 12,578 (south and centre cell blocks, spring 1983)	S. Holohan, ISS data
		* WRSA 7,000 = 9.6% censused coastal wintering population (72,996) in South America	ISS 1981 Morrison and Ross (1989)
		* SBDO 5,000+ = 10.2% of coastal South American wintering population (48,859)	ISS 1983 Morrison and Ross (1989)
		* HUGO 600+ = 4.7% South American Pacific coast wintering population (12,813);	ISS 1983 Morrison and Ross (1989)
		200+ (15/5/76, 14/5/77, 14/5/78)	Gardner (1981)
		* YELL 5,400 (29/7/76) = 5.9% South American coastal wintering population (91,047)	Gardner (1981) Morrison and Ross (1981)
		- PESA 2,000 (29/7/76)	Gardner (1981)
		- WIPH 1,000 (22/5/78)	Gardner (1981)
		- DUNL 2,200+	ISS 1983
		- RUTU 200 (26/5/75, 22/5/76)	Gardner (1981)
3. Shoal Lakes, Man.	R?/E	- PIPL c. 80 (1985) = 3% Great Plains population (2,652); 64 (1990)	Haig 1987, Haig & Oring (1988), Haig et al. (1988), Koonz (1990)
		- single day counts all shorebirds: 2,989 spring 1987; 376 fall 1987	Dickson unpubl. data
4. Gull Bay, Lake Winnipeg, Man.	E	- PIPL 47 ad (1989), 50 (1990) = 2% Great Plains population	Koonz (1989, 1990)
5. Whitewater Lake, Man.	R	* WRSA 10,000 (1988) = 13.7% censused coastal wintering population (72,996) in South America	ISS Morrison & Ross (1989) Dickson & Smith (1988) Smith & Dickson (1989)
		* max. 23,068 (spring 1987, one day count)	

Appendix 5 (continued).

6. Old Wives Lake/Chaplin Lake/Reed Lake, Sask.	H/E		
6.1 Old Wives Lake/Chaplin Lake, Sask.	H/E	* SAND estimated 51,654 (spring 1987) = 46.2% South American coastal wintering population (111,815) - one day count 124,165 (Old Wives Lake 64,392, Chaplin Lake 59,773) (spring 1987)	aerial and ground surveys, Dickson & Smith (1988), Morrison & Ross (1989)
		- PIPL 292 = 11.0% Great Plains population (2,652)	Harris et al. (1985) Haig et al. (1988)
		- BASA estimated 29,862 (spring 1987) - SESA estimated 30,404 (spring 1987)	CWS aerial and ground surveys, Dickson & Smith (1988)
		- WIPH 7,100 (Chaplin Lake) (20/6/84)	Harris et al. (1985)
6.2 Reed Lake, Sask.	R?	one day count 6,603 (24/5/87) - max. count 5,960 (?0/5/85)	CWS aerial survey, Dickson & Smith (1988), Smith & Dickson (1989) Gollop (1985)
7. Pelican Lake, Sask.	R	* max. 75,000+ (20-21/5/78) - MAGO 1,000 (13/8/78)	Serr (1978, 1979)
8. Lake Diefenbaker, Sask.	E	* PIPL 223 (1984) = 8.4% Great Plains population (2,652); 97 (1988); 94 (1989) - SBDO 437 (9/07/84)(1985)	Harris et al. (1985) Haig et al. (1988) Harris (1985a, 1988) Harris and Lamont (1989)

Appendix 5 (continued).

9. Quill Lakes, Sask.	H/E	* SAND 23,498 (Big Quill Lake, 28/5/88) = 24.1% South American Pacific coast wintering population (98,165) - HUGO 2,202 (Little Quill Lake) (1987) = 17.2% South American Pacific coast wintering population (12,813); 2,073 (Little Quill Lake) (1989) = 16.1% South American Pacific coast wintering population (12,813) - max. count 155,008 (Big Quill Lake) (1988) (no counts for Middle and Little Quill lakes in 1988) - max. count 59,913 (Middle and Little Quill lakes) (1989) (max. counts combined 214,921 for Quill Lakes (1988 ISS and 1989 CWS ground surveys)) - MAGO 1,200 (Big Quill Lake) (6/7/85) - PIPL 138 (1984), 298 (1985) = 11.2% Great Plains population (2,652) -REKN 1,123 (Little and Middle Quill lakes)(26/5/89); 400 (Big Quill Lake) (6/7/85) -SLSA 8,125 (Little and Middle Quill Lakes) (22/7/89); 13,600 (Big Quill Lake) (13/7/85) - YELL 9,000 (Big Quill Lake) (6/7/85) = 9.9% South American coastal wintering	ISS Morrison and Ross (1989) CWS ground surveys

Appendix 5 (continued).

		population - RNPH 29,483 (Big Quill Lake) (1988) - LESA 11,560 (Big Quill Lake) (1988) - DOWI 9,216 (1988)	ISS ISS ISS, CWS ground surveys - banding data suggest that 80%+ are LBDO
10. Kutawagon Lakes, Sask.	R?	- one day count 12,228 (spring 1988); one day count 5,654 (spring 1987) - LESA 1,000 (22/5/82)	CWS aerial survey Dickson & Smith (1988) Smith & Dickson (1989) Wedgewood (1982)
11. Last Mountain Lake, Sask.	R/E	- REKN 2,500 (21/5/72) - RUTU 2,500 (21/5/72) = c. 10% South American coastal wintering population (23,499) - one day count 5,078 (spring 1987) - one day count 4,283 (spring 1988) - max. 5,637 (1984 spring and fall) - MAGO 1,000 (31/8/65) - PIPL 10 (43 entire lake)	Lahrman (1972) Lahrman (1972) Morrison and Ross (1989) CWS aerial survey Dickson & Smith (1988) Smith & Dickson (1989) CWS aerial survey Colwell et al. (1988) Hatch (1966) Harris et al. (1985)
12. Burke/Porter /Buffer Lakes area, Sask.	R/I?		
12.1 Burke Lake/Porter Lake, Sask.	R/I?	* HUGO 1,978 (1979) = 15.4% South American Pacific coast wintering population (12,813); 847 (21/7/71); 1,150 (9/7/73)	O'Neil (1979) Morrison & Ross (1989) Gollop (1971) Harris (1974)
12.2 Buffer Lake, Sask.	R?	- one day count 10,672 (spring 1987)	CWS aerial surveys Dickson & Smith (1988) Smith & Dickson (1989)

Appendix 5 (continued).

13. Blaine Lakes, Sask.	R	- max. 29,861 (1989) - SAND 10,000 (18/5/89) = 10.2% South American Pacific coast wintering population (111,815)	CWS ground surveys CWS ground surveys Morrison & Ross (1989)
14. Lac Lenore/ Basin Lake, Sask.	R		
14.1 Lac Lenore, Sask.	R	* max. 25,000 (1989) - RUTU 312 (24/5/72)	CWS ground surveys Houston (1972)
14.2 Middle Lake/Basin Lake, Sask.	R?	- one day count 5,830 (25/5/88) - one day count 10,282 (30/5/88) - max. count 12,623 (1989)	CWS ground surveys CWS aerial surveys CWS ground surveys
15. Alberta/ Saskatchewan Border Region	H?/I/ E		
15.1 Cipher Lake, Alberta	R?	- one day count 5,000 (15/7/87) - max. count 10,021 (1989)	CWS ground surveys
15.2 Gillespie Lake area, Alberta	R?	- max. count 16,854 (spring 1988) - SLSA 10,000 (21/5/88)	CWS ground surveys
15.3 Gooseberry Lake, Alberta	R?	- max. count 10,765 (1987) - max. count 13,503 (1988) - max. count 14,719 (1989) - RNPH 10,000 (autumn 1987); 7,500 (spring 1987) - SAND 2,500 (1989)	CWS ground and aerial surveys

Appendix 5
(continued).

15.4 Killarney Lake/ Leane Lake, Alberta	R	* RNPH 20,000 (25/5/89) * one day count 27,542 (1989) - one day count 17,170 (16/5/84)	CWS ground surveys Wershler (1987)
15.5 Killsquaw Lake, Sask.	R?	- one day count 7,259 (spring 1987)	CWS aerial surveys Smith & Dickson (1989)
15.6 Landis Lake, Sask.	R	* one day count 24,790 (22/5/89) - RNPH 11,890 (22/5/89)	CWS ground surveys
15.7 Manito/Wells Lakes, Sask.	R/E	* one day count 28,702 (spring 1987) * one day count 36,847 (spring 1989) * RNPH 26,530 (spring 1987) * RNPH 34,245 (20/5/89) - PIPL 27 (Manito Lake, 1984)	Harris et al. (1985) (E = Manito Lake only)
15.8 "Metiskow Lake", Alberta	R?	- max. count 17,703 (1988) - BASA 10,000 (21/5/88) - max. count 13,487 (1989)	
15.9 Muddy Lake, Sask.	R?	- one day count 10,654 (spring 1987)	
15.10 Opuntia Lake, Sask.	R?	- one day count 5,791 (spring 1988)	

Appendix 5
(continued).

15.11 Reflex Lakes, Alberta	I/E	- max. count 35,948 (1989) * SAND 20,000 (27/5/89) = 20.4% South American Pacific coast wintering population (98,165); 3,100 (26/5/85) = 3.2% South American Pacific coast wintering population 4,000 (1/6/88) = 4.1% South American Pacific coast wintering population - RNPH 10,000 (1989) - PIPL 26 (4/5/85), 46 (17/5/86); 20 (1989); 34 (1990)	CWS ground surveys Wershler (1987), Wershler and Wallis (1987), Goossen (1990, in prep.): PIPL on westernmost Reflex Lake only
15.12 Sounding Lakes, Alberta	R/E	max. count 55,803 (1987) - LEYE 11,480 (autumn 1987) - YELL 13,532 (spring 1987) = 14.9% South American coastal wintering population (91,047) - SAND 3,000 (27/5/83) - AMAV 900 (autumn 1987) - PIPL 27 (1986)	CWS aerial and ground surveys Morrison & Ross (1989) Wershler (1987) Wershler and Wallis (1987)
16. Chappice Lake, Alta.	R?/E?	- max. count 10,992 (1988) - SAND 4,500 (spring 1988) = 4.6% South American Pacific coast wintering population (98,165) - PIPL 17 (1986)	CWS aerial and ground surveys Morrison & Ross (1989) Wershler and Wallis (1987)

Appendix 5 (continued)

17. Sullivan Lake, Alta.	R?	- max. count 14,130 (1989)	CWS ground surveys
18. Beaverhill Lake, Alta.	R	* max. count 23,442 (1989)	(CWS/Beaverhill Bird Observatory (BBO) ground surveys
		- max. 13,096 (1986)	ISS
		- RNPH 7,000 (9/9/89); 10,000 (1986)	
		- PESA 10,000 (1978), 1,000 (12/5/84)	Decker (1982) Gollop (1984)
		- BBSA 1,500 (1978), 700 (25/5/83 and 28/5/84)	Decker (1982) Cuthiel (1983) Gollop (1984)
		- REKN 300 (25/5/83), 200 (1978)	Cuthiel (1983) Decker (1982)
		- RUTU 200 (25/5/83)	Cuthiel (1983)
		- WRSA 1,100 (1978)	Decker (1982)
		- BBPL 300 (1978)	Decker (1982)
19. Hanna area, Alta.	E	PIPL 125	Wershler (1989), Wershler and Wallis (1987), Shandruk and Fortin (in prep.)
		- one day count all shorebirds 1,021 (May 1987)	Smith and Dickson (1989)
20. Rockland Bay/"Rider Lake" , Alta.	E	PIPL 47 (1989-1990)	Goossen (1990, in prep.)
21. Kimiwan Lake, Alta.	R	* max. count 27,067 (1988)	CWS aerial and ground surveys
		* one day count 21,212 (19/5/88)	
		- DOWI 12,000 (spring 1988)	probably LBDO
		- PESA 7,000 (spring 1988)	
22. Whitford Lake, Alta.	R	- one day count >20,000 (May 1991)	E. Eraschuk pers. comm.

Appendix 6. Potential WHSRN sites in Pacific Canada

Location	Type	Shorebird numbers	References, comments
1. Tofino Flats /Chesterman Beach, Vancouver Island, BC	R/I?	WESA: Tofino Flats - max. 16,400 May 1988, max. 22,600 August 1989; assuming 3-day turnover, max. spring est. 45,000, max. autumn est. 164,100, annual total = 209,700; Chesterman Beach - avg. autumn max. 35,000 (estd. 38% BC coast total (91,650)	Butler unpubl., Butler and Kaiser (1988), Butler et al. (1991), Butler et al. (1987)
2. Delkatla Slough, Queen Charlotte Islands, BC	R?	WESA avg. peak = 3,000 (estd. 3% BC coast total)	Butler and Kaiser 1988)
3. Fraser River Delta, BC	H	600,000 shorebirds (monthly counts summed over one year)	Butler and Cannings (1989)
		WESA avg. peak = 44,000; max. spring = 62,000; max. autumn = 22,500	Butler & Campbell (1987); populations may be much greater because of rapid migration/turnover (see Butler et al. 1987);
		WESA spring peak 1990 100,000; autumn peak 1990 55,000	Butler, unpubl.
		DUNL 25,000 - 40,000 winter 1979/80; fall peak 109,250 (1979); spring peak 60,000 (1980) and 126,000 (1989); fall peaks for Roberts Bank 38,000 and Sturgeon Bank 15,000	Fry (1980), Butler and Cannings (1989)
4. Hansen's Lagoon, BC	R?	WESA max. 1,650 (estd. 2% BC coast total)	(Butler and Kaiser 1988)